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An American National Standard

Standard Specification for Steel Castings, Carbon, for General Application[1]

This standard is issued under the fixed designation A 27/A 27M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers carbon steel castings for general applications that require up to 70 ksi [485 MPa] minimum tensile strength.

NOTE 1—The grades covered by this specification represent materials that are suitable for assembly with other steel castings or wrought steel parts by fusion welding. It is not intended to imply that all these grades possess the same degree of weldability or that the same welding techniques can be used on all castings. It is the responsibility of the purchaser to establish for himself a suitable welding technique.

1.2 Several grades and two classes of steel castings are covered, as indicated below. The grade and class desired shall be specified by the purchaser.

1.2.1 *Grade N-1*—Chemical analysis only.

1.2.2 *Grade N-2*—Heat-treated but not mechanically tested.

1.2.3 *Grade U-60-30* [415-205]—Mechanically tested but not heat-treated.

1.2.4 *Grades 60-30* [415-205], *65-35* [450-240], *70-36* [485-250], *and 70-40* [485-275]—Heat-treated and mechanically tested.

1.2.5 Class 1 and Class 2 steel castings shall be specified in accordance with 9.2.

1.3 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification. Inch-pound units are applicable for material ordered to Specification A 27 and SI units for material ordered to Specification A 27M.

2. Referenced Documents

2.1 *ASTM Standards:*

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products[2]

A 732/A732M Specification for Castings, Investment, Carbon and Low-Alloy Steel for General Application, and Cobalt Alloy for High Strength at Elevated Temperatures[3]

A 781/A781M Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use[3]

3. General Conditions for Delivery

3.1 Material furnished to this specification shall conform to the requirements of Specification A 781/A 781M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification A 781/A 781M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification A 781/A 781M, this specification shall prevail.

4. Ordering Information

4.1 Orders for material under this specification should include the following information in proper sequence.

4.1.1 Quantity,

4.1.2 Specification, grade (1.2), and class (9.2),

4.1.3 Description of the casting by pattern number or drawing,

4.1.4 Options in the specification, and

4.1.5 Supplementary requirements desired, including standards of acceptance.

5. Heat Treatment

5.1 All castings of Grades N-2, 60-30 [415-205], 65-35 [450-240], 70-36 [485-250], and 70-40 [485-275] shall be heat-treated by full annealing, normalizing, normalizing and tempering, or quenching and tempering. Unless otherwise specified in the inquiry, contract, or order, the castings may be heat-treated by any one or combination of these heat-treatments at the option of the manufacturer.

5.1.1 Heat-treatment shall be performed after castings have been allowed to cool from the pouring temperature to below the transformation range.

5.2 Furnace temperatures for heat-treating shall be regulated by the use of pyrometers.

6. Chemical Composition

6.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 1. Product analysis

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.18 on Castings.

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[2] *Annual Book of ASTM Standards*, Vol 01.03.

[3] *Annual Book of ASTM Standards*, Vol 01.02.

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TABLE 1 Chemical Requirements

Grade[A]	Composition, %				
	Carbon,[B] max	Manganese,[B] max	Silicon, max	Sulfur, max	Phosphorus, max
Grade N-1	0.25	0.75	0.80	0.06	0.05
Grade N-2	0.35	0.60	0.80	0.06	0.05
Grade U-60-30 [415-205]	0.25	0.75	0.80	0.06	0.05
Grade 60-30 [415-205]	0.30	0.60	0.80	0.06	0.05
Grade 65-35 [450-240]	0.30	0.70	0.80	0.06	0.05
Grade 70-36 [485-250]	0.35	0.70	0.80	0.06	0.05
Grade 70-40 [485-275]	0.25	1.20	0.80	0.06	0.05

[A] Specify Class 1 or Class 2 in addition to grade designation (see 9.2).
[B] For each reduction of 0.01 % carbon below the maximum specified, an increase of 0.04 % manganese above the maximum specified will be permitted to a maximum of 1.40 % for Grade 70-40 [485-275] and 1.00 % for the other grades.

tolerances shall conform to the Product Analysis Tolerances shown in Specification A 781/A 781M. When residual element chemical content is of interest to the purchaser, S54 may be considered.

7. Tensile Properties

7.1 Except for Grades N-1 and N-2, one tension test shall be performed on each heat and the mechanical properties thus determined shall conform to the requirements specified in Table 2. The tension test shall be performed in accordance with Test Methods and Definitions A 370.

7.2 Test bars shall be poured in special blocks similar to those shown in Fig. 1 of Specification A 781/A 781M and from the same heat as the casting represented.

7.3 Test coupons may be cut from the heat-treated (if required) castings or cast integrally with the castings at the producer's option.

7.4 The test bars for heat-treated castings shall be heat-treated in production furnaces to the same procedure as the castings they represent. When specified by the purchaser, the test bars shall be heat-treated with the castings.

7.5 Test specimens shall be machined to the form and dimensions shown in Figs. 4 and 5 of Test Methods and Definitions A 370.

7.6 If any specimen is machined improperly or if flaws are revealed by machining or during testing, the specimen may be discarded and another substituted from the same heat.

7.7 When this specification is applied to investment castings, test coupons and tension test specimens shall be obtained and prepared as directed in S3.2 of Specification A 732/A 732M. Test coupons shall be heat treated as prescribed in 7.4.

8. Retests

8.1 If the results of the mechanical tests for any heat, lot, or casting do not conform to the requirements specified, retests are permitted as outlined in Test Methods and Definitions A 370. At the manufacturer's option, castings may be reheat-treated and retested. When castings are reheat-treated, they may not be reaustenitized more than 3 times without the approval of the purchaser. Testing after reheat treatment shall consist of the full number of specimens taken from locations complying with the specification or order.

9. Rework and Retreatment

9.1 All welds shall be inspected to the same quality standards as were used to inspect the casting.

9.2 If postweld heat-treatment is required, Class 1 must be specified along with the grade, and the welds to be heat-treated must be defined. If postweld heat-treatment is not required, Class 2 must be specified along with the grade.

10. Keywords

10.1 castings; general application; steel

TABLE 2 Tensile Requirements

Grade[A]	Tensile Strength, min, ksi [MPa]	Yield Point, min, ksi [MPa]	Elongation in 2 in. [50 mm], min, %[B]	Reduction of Area, min, %
Grade U-60-30 [415-205]	60 [415]	30 [205]	22	30
Grade 60-30 [415-205]	60 [415]	30 [205]	24	35
Grade 65-35 [450-240]	65 [450]	35 [240]	24	35
Grade 70-36 [485-250]	70 [485]	36 [250]	22	30
Grade 70-40 [485-275][C]	70 [485]	40 [275]	22	30

[A] Specify Class 1 or Class 2 in addition to grade designation (see 9.2).
[B] When ICI test bars are used in tensile testing as provided for in this specification, the gage length to reduced section diameter ratio shall be 4 to 1.
[C] Grade 70-40 [485-275] may be used to meet the requirement of Grade 70-36 [485-250], when agreed upon between the manufacturer and the purchaser.

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SUPPLEMENTARY REQUIREMENTS

A list of standardized supplementary requirements for use at the option of the purchaser is described in Specification A 781/A 781M. Those which are considered suitable for use with this specification are listed below by title only. Additional supplementary requirements suitable for use with this specification at the option of the purchaser are described below. One or more of the supplementary requirements indicated below may be included in the purchaser's order or contract. When so included, a supplementary requirement shall have the same force as if it were in the body of the specification. Supplementary requirements details not fully described shall be agreed upon between the purchaser and the supplier, but shall not negate any of the requirements in the body of the specification.

S1. Magnetic Particle Examination

S2. Radiographic Examination

S3. Liquid Penetrant Examination

S4. Ultrasonic Examination

S6. Certification

S8. Marking

S9. Charpy Impact Test

S10. Hardness Test

S12. Test Report

S13. Unspecified Elements

S14. Tension Test from Castings

S51. Permissible Variations in Dimensional Tolerances for Castings Made from Mounted Patterns

S51.1 Tolerances for commercial steel castings (S51.1.1) made from mounted patterns and the surfaces that are not to be machined shall be in accordance with Table 3. Metal match plate patterns and precise molding methods can produce closer tolerances than the values shown in Table 3. Complex casting designs may require different permissible variations than those listed in Table 3.

TABLE 3 Normally Expected Deviation of Linear Casting Dimensions from Design Dimensions

Blueprint Dimension, in. [mm]	Tolerances, in. [mm]	
Up to 3 [75], incl	+1/32 [3]	−3/32 [2]
Over 3 to 7 [75 to 175], incl	+5/32 [4]	−4/32 [3]
Over 7 to 20 [175 to 500], incl	+6/32 [5]	−5/32 [4]
Over 20 to 100 [500 to 2500], incl	+8/32 [6]	−6/32 [5]

S51.1.1 The term "commercial castings" does not cover castings requiring special fixtures for gaging, or finishing castings by grinding to special tolerance gages beyond the normal requirements as listed in Table 3.

S52. Gate and Riser Projections for Castings Made from Mounted Patterns

S52.1 Castings shall have gates and risers removed in such a manner that no riser or gate stub projects or a depression is made beyond or below the casting design contour in an amount that would exceed the values given in Table 4.

S53. Weight Deviation for Castings Made from Mounted Patterns

S53.1 The allowable deviations from the average casting weight are shown in Table 5.

S54. Chemical Analysis for Residual Elements

S54.1 The manufacturer shall determine the percentage of elements specified as follows, using procedures specified in

TABLE 4 Gate and Riser Projection Tolerances

Riser or Gate Maximum Dimension, in. [mm]	Maximum Projection, in. [mm]	Maximum Depression, in. [mm]
Up to 4 [100], incl	1/8 [3]	1/8 [3]
Over 4 to 8 [100 to 200], incl	1/4 [6]	1/8 [3]
Over 8 to 20 [200 to 500], incl	3/8 [10]	1/8 [3]
Over 20 to 30 [500 to 750], incl	1/2 [13]	1/4 [6]
Over 30 [750]	3/4 [19]	1/4 [6]

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Specification A 781/A 781M. The chemical analysis thus determined shall conform to the following requirements:

Copper, max, %	0.50
Nickel, max, %	0.50
Molybdenum, max, %	0.25
Chromium, max, %	0.50

S54.2 Total content of these residual elements, maximum percent 1.00 .

TABLE 5 Allowable Deviation[A] from Average Casting Weight

Casting Weight, lb [kg]	Positive Deviation, %	Negative Deviation, %
Up to 100 [45], incl	8.0	8.0
Over 100 to 500 [45 to 230], incl	6.5	5.0
Over 500 to 10 000 [230 to 4540], incl	5.0	3.0
Over 10 000 [4540]	3.0	2.5

[A] Deviations do not apply to mass as calculated from a design drawing.

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